We Claim:

1. A method of imaging objects in a medium, the objects having specific impedances which are different from the specific impedance of the medium comprising,

a) applying an electrical current to the medium at various locations,

b) detecting voltages produced by the current which has passed through the medium from the surface of the medium at various locations,

c) iteratively repeating steps a) and b), changing the value and locations for applying the electrical current and measuring the voltages,

d) successively determining the region of the medium in which the objects are located with increasing accuracy by processing values of the detected voltages, using an algorithm to solve the field conditions in the medium, thereby determining a region in the medium in which the objects are located,

e) successively determining the location, shape, and conductivity of the objects with increasing accuracy by

i) determining a pattern of convergence,

ii) selecting a function which approximates the determined pattern,

iii) extrapolating the function for a predetermined number of iterations,

iv) determining the boundary conditions of the region of objects

v) repeating the iterations in the region defined by the boundaries, until convergence of the pattern and the values of voltage occurs, and

f) displaying the results graphically.

2. A method of imaging objects in a medium, the objects having a specific impedance which is different than the specific impedance of the medium comprising

a) initializing the conductivity distribution K,

b) running a basic algorithm for n iterations,

c) saving the conductivity distribution,

d) locating peaks with a peak detection method at n + 1 iterations,

e) compensating for resolution with a new conductivity scheme at n+2 iterations,

f) comparing calculated with known K for agreement,

i) if agreement is obtained, output results,

ii) if no agreement is obtained rerun step e).

3. A method as claimed in claim 2, wherein between steps a) and b) the following process is carried out,

a1) determine if step a) is an initialization or a reinitialization,

a2) if a reinitialization linking predicted conductivity k_d to basic algorithm,

a3) correct predicted conductivity by running it in the basic algorithm unit until convergence, and

a4) output results,

a5) if step a) is not a reinitialization step,

a6) initialize by running the basic algorithm for n iterations,

a7) model conductivity k and potential ϕ distributions over 1 to n iterations,

a8) predict conductivity k distribution at iteration I , and then run steps b) to f).

4. A method as claimed in claim 3, wherein the basic algorithm comprises:

(a) applying electrical input currents at a plurality of selected current input sites of said structures, each of said electrical input currents flowing within at least one of said regions and exiting from said structure at a selected current output site thereof;

(b) measuring the voltages generated by each of said applied currents at a plurality of selected voltage measuring sites of said structure with respect to a voltage reference point, each of said selected voltage measuring sites being remote from the current input and output sites through which flows the current generating said voltages;

(c) calculating the voltages ϕ at a plurality of locations within said structure, including said selected voltage measuring sites, with respect to said voltage reference point from the equation

$$-\Delta_{\cdot\kappa}\Delta\phi=f,$$

where k is a value of conductivity assumed for each of said locations and f is the density of each of the electrical input currents at said current input and output sites, the current traversing the surface of said structure except at said current input and output sites being assumed equal to zero;

(d) calculating the electrical current flux density $\overline{J}$ at each of the locations for which the voltage was calculated in step (c) from the equation

$\bar{J} = -k\nabla\phi;$

(e) comparing the voltages calculated in step (c) for each of said selected voltage measuring sites of said structure and the corresponding voltages measured at said selected sites in step (b);

(f) repeating steps (c) and (d) when the difference between the voltages compared in step (3) are greater than a predetermined amount, the voltages measured in step (b) then being substituted at said selected voltage measuring sites for the voltages calculated in step (c);

(g) calculating new values for k for each of said locations when the squared residual sum R equals

$$\sum_{X} \iint_{V} (\bar{J} + k\nabla\phi) . (\bar{J} + k\nabla\phi) dv$$

where V is the region over which the imaging is being performed and X represents the excitations over which the sum is taken, by determining the values of K which minimize R throughout said structure; and

(h) repeating steps (f) and (g) until the voltages compared in step (e) do not exceed said predetermined amount.

5. A method of detecting malignant and benign tumors in a breast comprising positioning an electrode array consisting of pairs of electrodes on the surface of the breast, passing current between selected pairs of electrodes sequentially, measuring the voltages between electrode pairs not carrying said currents, and

calculating the position, size and malignancy of tumors from the potential and

conductivity information derived from said voltage measurements.

6. A method of detecting malignant and benign tumors in a breast comprising positioning an electrode array consisting of pairs of electrodes on the surface of a dielectric container containing a conductive fluid, immersing said breast in said fluid, passing current between selected pairs of electrodes sequentially, measuring the voltages between electrode pairs not carrying said currents, and calculating the position, size, and malignancy of tumors from the potential and conductivity information derived from said voltage measurements.

7. A method of imaging an inhomogeneous or homogeneous medium and objects located therein, the objects having specific electrical properties which are different from the specific electrical properties of the adjacent medium comprising,

a) applying an electrical current to the medium at various locations,

b) detecting voltages produced by the current which has passed through the medium from the surface of the medium at various locations,

c) repeating steps a) and b), changing the value and locations for applying the electrical current and measuring the voltages,

d) successively determining the region of the medium in which the objects are located with increasing accuracy by processing values of the detected voltages,

using an algorithm to solve the field equations in the medium, thereby determining a region in the medium in which the objects are located,

e) successively determining the location, shape, and conductivity of the objects with increasing accuracy by

i) determining a pattern of convergence,

ii) selecting a function which approximates the determined pattern,

iii) extrapolating the function for a predetermined number of iterations,

iv) determining the boundary conditions of the region of objects

v) repeating the iterations in the region defined by the boundaries, until convergence of the pattern and the values of voltage occurs, and

f) displaying the results graphically.

8. A method of imaging an inhomogeneous or homogeneous medium and objects located therein, the objects having specific electrical properties which are different than the specific electrical properties of the adjacent medium comprising

a) initializing the electrical properties distribution,

b) running the basic algorithm for n iterations,

c) saving the conductivity distribution,

d) locating peaks with a peak detection method at n + 1 iterations,

e) compensating for resolution by applying the basis algorithm withiin the restricted region with a new conductivity scheme at n+2 iterations,

f) comparing calculated potential with measured potentials for agreement,

i) if agreement is obtained, output results,

ii) if no agreement is obtained rerun step e).

9. A method as claimed in claim 8, wherein between steps a) and b) the following process is carried out,

a1) determine if step a) is an initialization or a reinitialization,

a2) if a reinitialization linking predicted conductivity k_d to basic algorithm,

a3) correct predicted conductivity by running it in the basic algorithm unit until convergence, and

a4) output results,

a5) if step a) is not a reinitialization step,

a6) initialize by running the basic algorithm for n iterations,

a7) model conductivity k and potential ϕ distributions over 1 to n iterations,

a8) predict conductivity k distribution at iteration I , and then run steps b) to f).

10. A method as claimed in claim 9, wherein the basic algorithm comprises:

(a) applying electrical input currents at a plurality of selected current input sites of said structures, each of said electrical input currents flowing within at least one of said regions and exiting from said structure at a selected current output site thereof;

(b) measuring the voltages generated by each of said applied currents at a plurality of selected voltage measuring sites of said structure with respect to a voltage reference point, each of said selected voltage measuring sites being remote from the current input and output sites through which flows the current generating said voltages;

(c) calculating the voltages ϕ at a plurality of locations within said structure, including said selected voltage measuring sites, with respect to said voltage reference point from the equation

$$-\Delta_{-K}\Delta\phi=f,$$

where k is a value of conductivity assumed for each of said locations and f is the density of each of the electrical input currents at said current input and output sites, the current traversing the surface of said structure except at said current input and output sites being assumed equal to zero;

(d) calculating the electrical current flux density $\overline{J}$ at each of the locations for which the voltage was calculated in step (c) from the equation

$$\overline{J}=-k\nabla\phi;$$

(e) comparing the voltages calculated in step (c) for each of said selected voltage measuring sites of said structure and the corresponding voltages measured at said selected sites in step (b);

(f) repeating steps (c) and (d) when the difference between the voltages compared in step (3) are greater than a predetermined amount, the voltages measured in step (b) then being substituted at said

selected voltage measuring sites for the voltages calculated in step (c);

(g) calculating new values for k for each of said locations when the squared residual sum R equals

$$\sum_{X} \iint_{V} (\bar{J} + k\nabla\phi)\cdot(\bar{J} + k\nabla\phi)\,dv$$

where V is the region over which the imaging is being performed and X represents the excitations over which the sum is taken, by determining the values of K which minimize R throughout said structure; and

(h) repeating steps (f) and (g) until the voltages compared in step (e) do not exceed said predetermined amount.

11. A method of detecting malignant and benign tumors in a breast comprising positioning an electrode array on the surface of the breast, passing current between selected pairs of electrodes sequentially, measuring the voltages between electrode pairs not carrying said currents, and calculating the position, size and malignancy of tumors from the potential and conductivity information derived from said voltage measurements.

12. A method of detecting malignant and benign tumors in a breast comprising positioning an electrode array on the inner surface of a dielectric container containing a conductive fluid, immersing said breast in said fluid, passing current between selected pairs of electrodes sequentially, measuring the voltages between

electrode pairs not carrying said currents, and calculating the position, size, and malignancy of tumors from the potential and conductivity information derived from said voltage measurements.

13. A method of detecting malignant and benign tumors in a body part comprising positioning an electrode array on the surface of the body part, passing current between selected pairs of electrodes sequentially, measuring the voltages between electrode pairs not carrying said currents, and calculating the position, size and malignancy of tumors from the potential and conductivity information derived from said voltage measurements.

14. A method of detecting malignant and benign tumors in a body part comprising positioning an electrode array on the inner surface of a dielectric container containing a conductive fluid, immersing said body part in said fluid, passing current between selected pairs of electrodes sequentially, measuring the voltages between electrode pairs not carrying said currents, and calculating the position, size, and malignancy of tumors from the potential and conductivity information derived from said voltage measurements.

15. A method as in claim 5 and displaying the calculated position, size and malignancy.

16. A method as in claim 6, and displaying the calculated position, size and malignancy.